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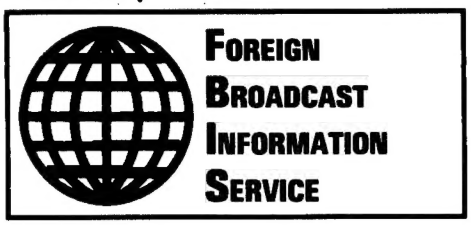

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CONTENTS

[The following are translations of selected articles in the Russian-language monthly journal AVIATSIYA I KOSMONAVTIKA published in Moscow. Refer to the table of contents for a listing of any articles not translated.]

Air Forces Deputy CinC Borsuk on Gulf War, Combat Training Support

92UM0103A Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 7, Jul 91 (signed to press 19 Aug 91) pp 2-3

[Interview with Air Forces Deputy Commander-in-Chief Honored Military Pilot USSR Lieutenant-General Aviation Anatoliy Fedorovich Borsuk by AiK correspondent under the rubric "Combat Training: Prospects for Improvement": "Corrections Are Needed"]

[Text] *The results of the military conflict in the Persian Gulf region will be the subject of careful study by policy-makers and the military for a long time to come yet. But one fact, unpleasant for us, jumps right out at you—the defeated were troops that were armed, by and large, with Soviet hardware that had been mastered with the aid of Soviet specialists. Readers of the journal are expressing doubts regarding the sufficiency of the level of fighting ability of our own armed forces, including the Air Forces, in this regard. Air Forces Deputy Commander-in-Chief Honored Military Pilot USSR Lieutenant-General Aviation A.F. Borsuk reflects on this, as well as on the course of combat training for Soviet fliers, in a discussion with a correspondent from this journal.*

[Correspondent] Comrade Lieutenant-General, the easy victory of the multi-national forces in the war against Iraq and the incomparable losses of the two sides are frequently held by the mass media and letters from our readers to be the result of serious holes in the combat proficiency of the Iraqi troops, including fliers with the latest types of combat aircraft at their disposal. What can you say on that score?

[A.F. Borsuk] One cannot reduce the defeat of the Iraqi Army to holes in combat proficiency alone. The rout of Hussein's adventure was pre-ordained from the moment of its condemnation by the majority of countries around the world, including Arab ones. The unity of the nation has also proved to be illusory, as testified by the uprising of the peoples of Iraq against the dictatorial regime following the defeat.

Combat proficiency embodies not only the soldier's ability to handle his weapon, but his moral spirit as well. One can be taught to handle military hardware competently, but how were our specialists to foster bravery, boldness and the ability to conduct themselves in battle in the Iraqi servicemen in this case? It was the policies and strategy for waging the war by Iraq and the moral spirit of its army, not combat proficiency, that suffered defeat.

The enormous difference in the losses of the two sides was a consequence of the incomparability of the opposing forces in both quantitative and qualitative regards—the most modern and select armed forces were arrayed against the Iraqis.

As for aviation, the number of combat aircraft in the multi-national forces was more than triple the number for the enemy, and they were fitted with the latest-model aviation gear with high combat performance characteristics. Only about ten percent of the aircraft in the Iraqi Air Forces were modern ones produced by us.

The unexpectedness of the attack, the total air supremacy, the use of cruise missiles and AWACS aircraft and the comprehensive use of EW gear all played a role as well. The coalition's wager on aviation was justified; air strikes knocked out air defenses, substantially undermined the military and economic potential of the enemy and lowered the morale of his troops, which eliminated their opposition in the ground operations.

Iraqi aviation was used sporadically, since the principal wager was placed on a land battle. Its mission was to be preserved via the placement of aircraft in underground bunkers on their own territory and their redeployment to Iran. Until "better" times, as they say. But when those times came, it was time to leave Kuwait. There is thus no cause to talk about the quality of combat proficiency of the Iraqi pilots.

[Correspondent] Nonetheless, how do you assess the course of combat training for our fliers against the background of the Near East conflict?

[A.F. Borsuk] The conflict in the Persian Gulf region is forcing us to think about opportunities for raising the role of the Air Forces in contemporary warfare, their operational employment and combat training for aviation units and subunits, and to make the appropriate corrections in all of those areas. One can judge the actual combat proficiency of our fliers from the actions of Soviet pilots in Afghanistan, where they demonstrated quite high training and moral spirit. One can thus assert that our Air Forces are able to repel an aggressor in the event of an attack on the USSR. It is not yet clear how the pilots of the anti-Iraq forces would have conducted themselves had they encountered well-organized resistance.

Afghanistan, however, is in the past, and one cannot live by that experience alone, or else we will become hopelessly behind. The Air Forces Combat Training Directorate is undertaking steps to improve combat training with a regard for modern requirements: gaps are being eliminated in the instructional training of supervisory personnel, and they are being granted more opportunities for initiative and creativity in raising the tactical flight proficiency of fliers; military schooling will begin to be implemented according to the new KBP [combat training course] for the aviation branch starting in 1992, and a number of other innovations will be appearing. The methodology for the combat training of our Air Forces will be viable, however, only with good support.

The supply of engines and spare parts, however, has fallen sharply over the last five years. The poor operational reliability of new aviation hardware and its decline for models long in service, along with the

shortage of combat trainers, modern simulators and computer hardware, is eliciting much concern. The understaffing of engineering and technical personnel and specialists in the support units has led to poor turnover in the basic aviation inventory—aircraft. All of this taken together, under the conditions of excess flight personnel as a result of cutbacks in the quantity of combat aircraft and the accelerated withdrawal of aviation units from Eastern Europe, has led to a worsening of the principal indicator of the combat proficiency of the pilot, his total annual flying time, which is currently 2.5 times less than scientifically substantiated and 3-4 times less than for combat pilots in the United States.

It is difficult to ask of commanders in all strictness that they maintain combat readiness at a sufficient level with such a state of affairs. The balance of forces will clearly not be in our favor if extreme steps are not taken to eliminate the aforementioned failures in supporting the combat training of Air Forces units. The more so as a surge of interest in mass orders and the production of the latest types of arms, which acquitted themselves well in the war with Iraq, as well as a rise in the prestige of the army are being observed in the United States and the other NATO countries. They are not discounting the possibility of military conflicts in the future, and they are preparing seriously for them.

Steps are undoubtedly being taken in the Air Forces command and higher up, but it is becoming more and more difficult to solve these problems under today's conditions.

[Correspondent] You assert that the new documents foster intelligent initiative and independence lower down. Some aviation commanders, at the same time, are categorically refuting that, feeling that the existing documents are destroying everything progressive at the roots. What, in your opinion, is the essence of this contradiction?

[A.F. Borsuk] The essence is namely, first of all, that some commanders are not studying the basic guidelines, developed over recent years by Combat Training and other directorates and services of the Air Forces command, that take into account contemporary requirements and, by the way, the desires from the local areas, and emancipate the unit command on many issues in the organization and execution of combat training.

There is, on the other hand, an inability of some superior officers to make use of the initiative they have been granted, a fear of taking responsibility for oneself thereby. It is more convenient for them to command using the requirements of the prior documents, wait for instructions from above, "from uncle," who will answer for everything in the event of anything.

Some local commanders, guided by good intentions to ensure the safety of flight operations, moreover issue their own instructions that emasculate the substance, and sometimes even cancel the requirements, of the fundamental documents. How often are unnecessary do's and don'ts thrust on subordinates, overloading them with excessive documentation and overlapping their work? The flight and squadron commanders in a number of units, for example, are entirely removed from the setting of flight missions, the monitoring of readiness and from post-flight critique and analysis. This is all done for them by higher commanders, even though the rights and duties of each officer are clearly spelled out in the NPP [Manual of Flight Operations]. This frequently conceals the poor general education and instructional training of the ranking officers.

The leadership style of the commanders noted above causes yet another wave of dissatisfied people—their subordinates, right down to the rank-and-file pilots—who are always more ready to blame the higher officers for all sins than their immediate commander.

There are, of course, situations that put commanders within a certain framework, when mandatory conditions must be observed. The KPB, for example, provides exercises and the procedure for performing them that cannot be "leapfrogged" for the initial training of young pilots in advanced aerobatic maneuvering. There are, at the same time, no mandatory conditions for improving those pilots who have already been trained. And all of this is stipulated in the guidelines.

As for the fundamentals of the flight rules and regulations, they must be known and respected, and not disparaged in wholesale fashion. I would advise becoming familiar with them, and how respectfully they are regarded in other countries. I personally favor a methodological trunk for flight operations in the form of the combat training of the Air Forces, with the branches and leaves off it in the form of commanders and pilots with a creative approach to their martial labors.

[Correspondent] But won't you agree that there is something else that forces the commander to refrain from displaying the initiative, independence and intelligent risk without which a high level of combat proficiency obviously cannot be achieved? What is the degree of protection for the commander or pilot if something unforeseen happens?

[A.F. Borsuk] If I read between the lines correctly, you are perhaps touching on a very important and, at the same time, painful question. Before answering it directly, a few words about the vital necessity of combining high combat proficiency with the same level of assurance of flight safety.

Seemingly two incompatible concepts? Perhaps so to a certain extent, since the attainment of the high combat proficiency so essential in war always contains a certain share of risk, which is not always justified, for the commander and pilot.

A "yes" is therefore present in two cases, in my opinion. The first is when the commander "strains" after high combat proficiency without the observance of flight rules

and regulations, which leads to air mishaps, as a rule. The risk is unjustified, and there is no combat training, or safety either.

In the second case, the commanding officer "strains" after the achievement of flight safety by all means, as a rule through over-simplifications, prohibitions and the like. The goal is seemingly attained for some period of time, but then, as experience shows, air accidents pour forth as out of a horn of plenty. The risk was not justified, and the results are the same as the first case. The commander is thus squeezed on the one hand by safety, and on the other by the need for high combat proficiency.

Can they be combined then? There is one conclusion—the way to flight safety lies through high combat proficiency, which is attained first and foremost through the observance of methodological rules for pilots on the ground and in the air according to the principle of "from the simple to the complex" and the consolidation of skills in the course of improving their training. Confidence in their actions appears in both the commander and the pilot in that case, and they are ready to take a risk that will be justified by their high training. But one must not deprive oneself of one's alma-mater—the scientifically substantiated yearly flying-time standard—for this, as was already mentioned.

[Correspondent] But nonetheless, who will defend the commander or pilot from the random grievous consequences associated with the degree of risk of flight operations?

[A.F. Borsuk] I assume that should be done by the commission to investigate air accidents. A skilled investigation and elementary decency among the commission members in ascertaining the true causes of an air mishap, along with objectivity in the choice of punishment measures for namely the guilty, will provide the necessary protection for the commander or pilot against unfounded accusations. The desire to instill "order" using all available methods without consideration of their expediency, on the other hand, will lead to the punishment of a whole group of servicemen of varying categories and various types of restrictions and prohibitions, as well as to a new spiral of air accidents. Everyone in flight operations should be engaged in his own business and answer for it. When everyone answers for one and the same thing, that means no one answers for anything. Some commanders and flight-safety service specialists do not think about that and, as a rule, take the aforementioned second version. And as a result, if we have to fight, we will suffer large combat and non-combat losses due to poor combat proficiency, as the experience of past wars testifies. We must choose the lesser of the two evils and sometimes take a justified risk in the combat training of flight personnel. The level of mutual relations in our society is still far from an awareness of such concepts as the presence of a degree of risk in flight operations and the necessity of employing scientific forecasting of flight accidents—not as an end in itself, by the way, but in order to reduce the accident rate in the future.

[Correspondent] Tell us, in conclusion, about your own life and your route into aviation.

[A.F. Borsuk] My route to aviation was not distinguished by particular linearity. I was born in 1930 in the city of Ivanovo, to the family of a military pilot. That determined my choice of profession as well. I started flying in the ninth grade at the Moscow Central Air Club. I became a recreational pilot, and was studying at the MAI [Moscow Aviation Institute] at the same time. Then the Yeysk Naval Flight School. I began service as an officer as a flight instructor. I completed the Red Banner Air Forces Academy [VVA] in 1959, after which I served in line units. I was an instructor in the combat-training techniques department of VVA and an Air Forces flight-safety service inspector, and I returned to a line unit in 1966 as a deputy regimental commander. I held all posts and commanded large aviation formations. I have been at the Air Forces command since 1984. I have been flying for 35 years in all, principally in fighters and fighter-bombers. I have in my family someone continuing the flight tradition in the person of one of my two daughters—a USSR Master of Sport in helicopter sports. One of my granddaughters also dreams of becoming a pilot. But what can you do if there are no sons or grandsons... yet.

Tactics and Prospects for Fighting Stealth Aircraft

92UM0103B Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 7, Jul 91 (signed to press 19 Aug 91) pp 4-5

[Article by Doctor of Military Sciences and Professor Colonel (Retired) A. Krasnov under the rubric "For the Arsenal of the Combat Pilot": "Aerial Battle With 'Ghosts'"]

[Text] *The invention of radar, infrared and other methods of detecting flying targets has led to a revolution in the tactics of aerial warfare. Long- and medium-range missile weaponry has appeared on fighters. Long-range missile battle has gained paramount significance.*

But "invisible" aircraft have now begun to appear on both sides in the one-on-one combat between the sword and the shield, marking a certain return of the tactics of aerial battle full circle—to close-in maneuvering aerial combat. That is what Doctor of Military Sciences and Professor Colonel (Retired) A. Krasnov feels.

The aircraft manufactured using the Stealth technology use unusual aerodynamic shapes, radar-absorbing composite materials and other still-secret design features that create considerable difficulties for their detection in flight by ground and airborne radars in view of their

small radar cross-sections (EPR = 0.01 m^2). The low intensity of thermal emissions and low level of visual/optical and acoustic detectability do not permit the utilization of other means of detection to the fullest extent.

Fighter pilots are naturally troubled by the question of whether it is possible to fight these aircraft—which have received the lively names of "ghosts" and "invisibles," among others, abroad—at all. The experience of combat operations in the Persian Gulf region, where these craft took part in strikes against Iraqi air-defense targets, do give an answer to that question, since no aerial encounters between them and Iraqi fighters were established.

It should be stated first and foremost that the names "ghost" and "invisible" are just metaphors. The Stealth aircraft will never be completely invisible. The majority of ground radars and radar sights installed on fighters are able to detect them, just like cruise missiles and other small targets, but at significantly lesser ranges.

It is namely that circumstance that markedly restricts the opportunities for tracking such aircraft on command-post plotting boards and, consequently, guiding fighters to them for searches and timely aimed firings of missiles by pilots. The range of detection and lock-on of Stealth aircraft with the on-board radar of modern fighters, according to the foreign press, is not more than 20-25 and 15 km [kilometers] respectively. The ability of fighters to wage battle with such an enemy will thus be determined by the effectiveness of the search for him.

Ground command-and-control stations—which already have the capability of obtaining information on the flight of Stealth aircraft from meter-waveband radars, as well as stations for detecting aircraft from the operation of on-board electronics gear (radar, active-jamming transmitters)—can be of assistance in such cases. Special hopes should not be pinned on the latter, it is true, since enhanced-concealment radars with adaptive power regulation and constant frequency and pulse shape changes have been installed on the Stealth aircraft. The enemy is counting principally on the use of non-emitting apparatus (forward-scan infrared sets, electro-optic sights), as well as weaponry that does not require target illumination. It is recommended that the crews employ jamming transmitters only in cases where the safety of the flight is threatened, and then only with the minimal power for self-concealment.

One should nonetheless not neglect this information. It makes it possible to narrow the areas of expected location of Stealth aircraft, and will undoubtedly facilitate a rise in the effectiveness of searches.

The interception of low-signature aircraft from a ground-alert duty situation, as the calculations testify, is effectively ruled out. The opportunity does exist if the fighters are on airborne patrol or independent search. They can receive reference data on the direction of approach of the enemy or the time of his possible appearance from the command posts.

The choice of an expedient altitude, maneuver and combat formation for subunits in a search is a complicated one for the commander of a group of interceptors. He should proceed, as in times past, from the operational tactics of the enemy therein.

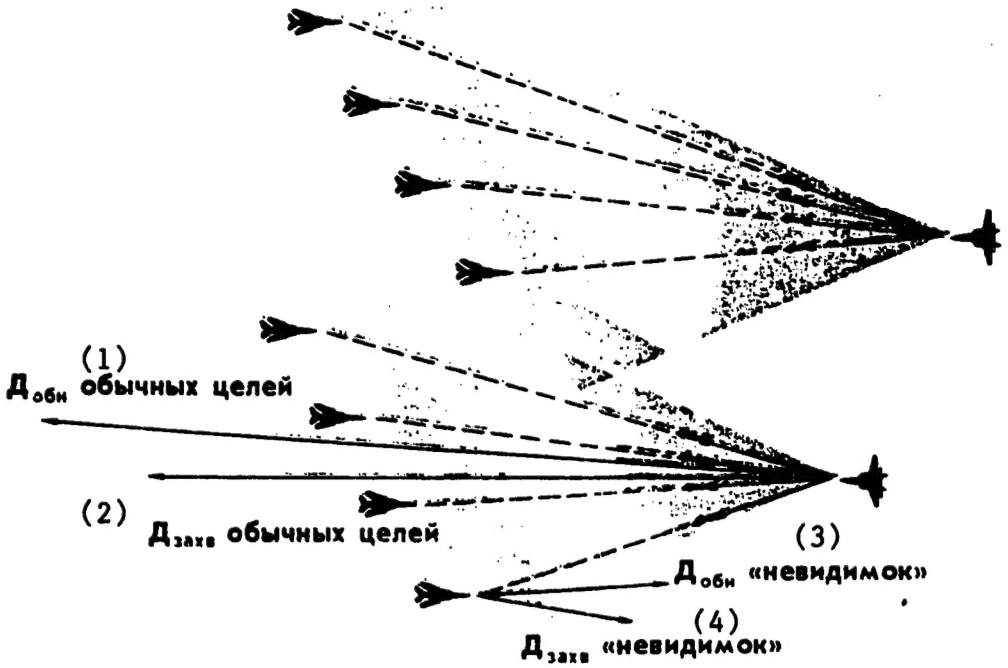
The Stealth aircraft can fly across the whole range of operational altitudes. Medium and high altitudes, however, are the most effective for the performance of combat missions by these aircraft, since they provide for an increased range of flight and target detection, launch of air-to-air missiles or the use of guided bombs.

As for the operations of the Stealth aircraft at the lowest possible altitudes, where the range of their detection by ground radars is minimal, the on-board terrain-following radar of the low-signature aircraft has to be used continuously, especially at night and in bad weather, and this exposes their flight.

The maneuvering and battle formation of the interceptor subunits can be determined proceeding from the general rule of observation of the maximum amount of airspace per unit time by on-board radars. The enemy's advantages cannot fail to be taken into account in that case, however: he could, thanks to the low level of telltale signs, be the first to detect the fighters at long range and undertake everything possible so as to remain undetected, including various evasive maneuvers for the preservation of the maximum possible distance and lowest aspect angle for illumination in relation to the fighters. Small intervals between fighters (no more than twice the range of detection of Stealth aircraft) must be observed when structuring the battle formation of the subunit, and their stacking in altitude and depth to parry the expected maneuvers by the target must be ensured. A significantly larger force will doubtless be required for this than searches for conventional aircraft.

But let us then say that despite all the impediments, they are able to detect the enemy. Today they are the F-117A tactical fighters and the B-2 strategic bombers, whose tactical performance characteristics are different, although both possess subsonic speeds, low thrust-to-weight ratios and maneuverability and are inferior in other combat performance characteristics to today's generation of interceptors. The aerial encounters of fighters with them would thus be a conventional battle were it not for their low detectability. That means that the discussion can only be of close-in aerial battle on the part of the interceptors, while the enemy has the opportunity of attacking considerably sooner. The chances are equalized, however, if the combat aircraft of the opposing sides have identical detectability features.

The Stealth aircraft can be visually identified by the following features: they are dark in color, and do not have large flat surfaces or gaps in the skin. A distinctive "rough" and "angular" shape is characteristic of the F-117A tactical fighter, reminiscent of an arrowhead from above. The B-2 bomber, as opposed to the F-117A, has been executed according to the "flying wing" design



Aerial battle of Stealth aircraft armed with AMRAAM missiles against conventional fighters

Key:
1. Detection range of conventional targets
2. Lock-on range of conventional targets
3. Detection range of Stealth targets
4. Lock-on range of Stealth targets

and is quite devoid of any empennage. The engines and armaments are concealed inside the well-"sleeked" fuselage, on which the air intakes are located.

The development of special tactical methods for aerial battle with the Stealth aircraft still lies ahead. There is still too little base data for calculations. The optimal directions for convergence and attack on the targets at which their radar cross-sections will be at a maximum are unknown, and the parameters of maneuvers ensuring battle only at short distances from the enemy, so that he cannot evade pursuit, have not bee determined.

How does one act if the enemy himself attacks fighters not possessing the properties of low detectability? We will assume that their convergence will take place head-on with Stealth aircraft armed with AMRAAM missiles using active radar homing heads and a control system for the middle leg of the trajectory (see figure). Compare the target lock-on ranges—15 and 70 km! No pilot will knowingly converge straight on with a target, knowing that his destruction with enemy missiles awaits him before he can launch his own. But what can they try then? There is unfortunately no complete answer to that question. Tactical measures founded on disorienting actions using on-board jamming equipment to suppress the sights and missile homing heads of the opposing side are essential when fighting under unequal conditions with a lack of surprise for the enemy. The development of anticipatory "protective" maneuvers based on the maximum capabilities of the aircraft and weaponry inherent in the on-board algorithms is needed. The "old" tactical methods that have proved their effectiveness before will clearly also not die out.

The F-117A and B-2 "ghost" aircraft, it is true, are not intended for waging maneuvering aerial combat, but they will be supplemented in the future with low-signature fighters to win air supremacy—the ATF fighter, for instance, whose entry into service with the American Air Force is planned starting in 1996. Its radar cross-section, according to data in the Swiss journal INTERNATIONAL DEFENCE REVIEW (1989, No. 9), will be one percent of the signature for the F-15 or F-16. Battle against actively opposing Stealth aircraft is thus a task for tomorrow. It must be assumed that our fighters will possess the same properties of low detectability and more advanced sights to detect and attack low-signature targets in the future as well.

One interesting circumstance could be foreseen here. If the opposing sides possess low-signature aircraft, the

battle of the "ghosts" will take on somewhat of a different nature compared to that shown in the figure. Attacks in the forward quadrant will be made extremely difficult due to the short ranges for the detection and lock-on of targets. All the features of aerial battles of the 1950s and 1960s will come to the forefront, where fighters did not yet have long- and medium-range missiles, as well as on-board sights for the long-range detection and lock-on of targets. A return to the past? Partly so!

In assessing the capabilities of modern fighters made using conventional technology, we will keep in mind that their chances for victory in battle against Stealth aircraft will increase to the extent of the development of fundamentally new means and methods of tracking the flight of low-signature aircraft (dual or bistatic radars, over-the-horizon radars and space-based systems). One must also not forget as well the professionalism of the flight personnel, their high moral and psychological tempering and their ability to wage battle visually using the weaponry they have.

Training and Experience for Military-Transport Copilots Inadequate

92UM0103C Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 7, Jul 91 (signed to press 19 Aug 91) pp 6-7

[Article by Major General Aviation A. Pavlenko under the rubric "Combat Training: Problems, Experience, Opinion": "Not Envisaged by the System"]

[Text] *Control is redundant in multiseat aircraft, so it would seem that both pilots can back each other up completely.*

It is far from so in practice, however. Aircraft copilots are only rarely permitted independent control of the aircraft, especially in bad weather, and essentially remain "assistant autopilots."

Many of them, after all, will become aircraft commanders in the future, and will be taking on responsibility for the performance of combat missions and the safety of passengers and crews. Are they ready for it?

Major-General Aviation A. Pavlenko, an honored specialist of the armed forces of the USSR, in this article discusses the problems of flight training of copilots and the measures being undertaken in military-transport aviation [VTA] to solve them.

The crew of Combat Pilot 1st Class Major R. Penkov was performing the mission of delivering cargo to one of the airfields in Primorskiy Kray. The weather conditions worsened sharply when the aircraft was already on its approach—the crosswinds had grown stronger, and a low cloud cover that had gathered in the direction of the sea had begun to cover the runway. There was just enough fuel to make it to the alternate airfield, but the weather there was unstable.

What to do here?

Major Penkov, weighing up all of the "pluses" and "minuses" and with the consent of the flight supervisor, decided to make the landing at the principal airfield. This decision was based on the pilot's profound knowledge of the high professional and psychological qualities of his subordinates, and first and foremost his copilot. The crew landed safely, displaying excellent proficiency and teamwork. The mutual trust that had taken shape in this small collective played a major role in the successful completion of the flight. The commander had no doubt of the abilities of the crew to perform the assignment. Mutual assistance and interaction in the air are where the confidence in oneself is based that allowed the fliers to escape a difficult situation.

The crew commander of a multiseat aircraft often has to make decisions connected with the fulfillment of flight assignments that should be well thought out. He is, after all, responsible not only for himself, but also for his subordinates, his cargo on board the craft and for the safe outcome of the flight.

Cases are not at all rare, however, when this seeming truism is completely forgotten, screened by the blind "faith" of the pilots in their strength and capabilities. It is fitting here to recall an air mishap that occurred with craft commander Captain A. Merkulov in a landing approach at a transpolar airfield. The fact that the weather at those latitudes abounds in insidious surprises is well known. The crew of the Il-76 happened to encounter one of them that night. How else to explain that, observing the runway from a distance of ten kilometers and guiding the aircraft surely along the glide path, Merkulov, getting into a snow squall, set the craft down 600 meters short of the runway? An aircraft that had just 30 hours of flying time since leaving the plant was broken up as a result. The people thankfully survived. No one, including the pilot himself, could even explain what had happened. What about the copilot? Why didn't he anticipate the misfortune? I am convinced that he was not ready for decisive actions at that moment—he did not have enough practical experience for it. And he thus put his trust only in his commander.

We have here, in other words, a failure to fulfill the strict requirement for the copilot to intervene and take control himself when they get into a situation in which the commander clearly cannot handle the piloting and is making gross errors.

Why did such a thing become possible? Where do the roots of this "disease" grow? I think that in order to delve into this, we need to begin the discussion at the stage of emergence of the future pilots of VTA.

The flight-training program at the Balashov school, as at other VVAULs [higher military aviation schools for

pilots], is reviewed repeatedly, and that is entirely natural. But what is noteworthy is that the results of the decisions made is always the same—consistent simplifications. The rejection of training for first-year students occurred, for example, in connection with the replacement of the L-29 aircraft with Yak-18As in the middle of the 1960s. While the total flying time for 1st and 2nd course cadets used to be 100 hours, it has now dropped to 65. The quality of the whole training process has worsened substantially as a result, with a significant increase in spending to conduct it.

Another "decisive" step was taken later—internships for last-year cadets in the line units as copilots on An-12 or Il-76 aircraft were instituted in the 1970s in place of training on the An-24. What did we get out of this? It turns out that on most flights the instructional crew was working for themselves, while the cadet was meanwhile shut out of controlling the aircraft in such crucial stages as takeoff, landing approach and landing. And no wonder. Why hand over your "ration" of flying time to an "alien" intern?! Let him come to us as a lieutenant, and then he can work some... The cadet is thus already prepared for what he should expect in the first years of flight service. And that is namely to start all over again in the right seat.

And what about the cherished dream of moving over to the commander's seat faster? At first glance it could seem that no particular barriers should arise on the path to realizing it for the young pilot, since just one copilot (from his own crew) has claims to the commander's seat. However...

Here I will permit myself a small digression, since one cannot fail to address an issue connected with the service advancement of flight personnel.

From the time of completion of the VVAUL until he heads a crew, the copilot "sits quietly at the controls" on flights—assisting the commander in controlling the aircraft—while actually losing his skills for independent piloting that he acquired as a cadet and consolidated in the regiment at the stage of emergence as a pilot. The improvement process is restricted thereby. And as bitter as it may be to hear, sometimes said ironically, that "The right thing for us to do is not to bother the left," that is how some copilots actually view the essence of their work.

I am in no way trying to present them as ballast (forgive the comparison) on board the aircraft. Yes, they receive the appropriate certifications for flight, their piloting technique is checked out etc. But is the quantity of training flights planned for them for the year (eight in the daytime and four at night) sufficient to raise the personal level of aerial proficiency from their position as part of an instructional crew? Where else but on flights with an experienced and expert pilot can a young pilot learn actions for this or that situation?! It is a good thing if the official relations in a crew between the commander and his copilot are structured on the basis of mutual respect and trust. Then the latter is granted the opportunity (the commander takes on the responsibility therein) of systematically consolidating his independent piloting skills and improving his flying mastery. If that does not happen, then the "maturation" process could be dragged out for as long as the line of "prospective" candidates for commander is, at the tail end of which are the pilots representing other arms of aviation who have proved to be in VTA by the whims of fate. An even more bitter fate awaits them, whatever you say—to remain "second forever."

It should be acknowledged for the sake of fairness that not all pilots prove to be suited for the position of aircraft commander. The reasons are most varied: poor professional qualities, lack of self-discipline, sometimes even their health does not permit it. Nonetheless, despite all of this, if "stagnation" in the selection of candidate commanders arises in some aviation regiment or squadron, their immediate superiors are accused of its "artificial creation" first of all: you are not preparing a fitting replacement, they say, you are not concerned with cultivating flight cadres... A problem meanwhile arises for the aviation commander—which of the not-quite-yet "fledged" young people does he advance to the position of aircraft commander? The answer seemingly suggests itself: the most experienced pilot, of course. And that is, at first glance, entirely fair. I would like to make a substantial clarification, however. The term "to fly" has a dual interpretation in greater aviation—to pilot an aircraft, and... to be ("sitting quietly at the controls") on board a flying aircraft. Whence the obvious unequal price of flying time. This nuance unfortunately remains unaccounted for by the VTA pilot training system. Many commanders, alas, also forget about it. But we will not judge them harshly, since they were also products of that system and are "cooking" in it even today. And there is clearly nothing left for some of them to do than designate only experienced pilots for higher positions.

It should be noted that an attempt was made in the recent past to raise the level of aerial proficiency of copilots, but it was simplified somewhat: via their "coaching" to the level of pilot 2nd class with flights as part of a regulation crew from their own position. The corresponding program was even incorporated into the VTA KPB [combat training course]!

This measure, however, like the others, proved to be a half-measure, since the fact of a rise in the class qualifications of a pilot's skill level in and of itself adds nothing, and the "incorporators" of the innovation cannot fail to know that. The fulfillment of the program, after all, was envisaged for implementation only through the integration of exercises for the commander and his copilot. The natural question arises of how two pilots can be controlling one aircraft in flight at the same time.

This measure naturally failed to improve the state of affairs in the flight training of crews. I say this because personal experience on check flights with candidates for the post of aircraft commander testifies to the fact that

many of them, setting about a challenge program on the Il-76 aircraft and having no little flying time behind them already, master it only with great difficulty. What is the reason?

I am convinced, every time I make instructional flights, that the pilot, like any person, is no stranger to the feeling of fear of the unknown. As soon as that unknown is identified and ascertained, it immediately ceases to cause any apprehensions. I thus feel it is necessary to express my own point of view that one must not hinder the trainee pilot's individual performance of maneuvers—that will give him enormous confidence in his own powers. If he is refused this, he will never know whether he will be able to perform a given maneuver.

It is completely obvious that the instructor, regardless of the qualifications of the trainee, should strive to develop in him the skills of independent resolution of this or that task, and reinforce the pilot's confidence in the fact that he can not only operate the aircraft, but pilot it.

This approach has now begun to be reflected to a certain extent in the new VTA KPB: the size of the curriculum for training copilots has been increased (by approximately four times) in it, allowing for cumulative "bitter" experience and the proposals and desires of fliers, through sections included in it for the first time whose principal content is the teaching, and mastery by pilots, of complex types of training when piloting the aircraft from his position. It envisages the execution of flights by the copilot (after he has received the appropriate certification) as part of a standard crew, with the piloting of the aircraft from takeoff to landing inclusive.

Whatever assessment this measure may be subjected to, it is clear that it is aimed first and foremost at achieving a level of aerial proficiency for copilots that would in reality be reflected in their proficiency ratings and would raise their professional authority. When this occurs (which I truly believe), then he—a highly trained pilot—can be called the second commander. And then retraining for the left seat after his naming to the higher post could be conducted under an accelerated program, analogous to the one that exists today for the training of flight instructors.

I would note in this connection the fact that the first tentative steps in the assimilation of such a program at the VTA Center for Combat Application and Retraining of Flight Personnel confirm its optimal nature for their acquisition of solid skills in piloting an aircraft from the commander's seat.

I do not entertain the hope that the transition from the existing system of training pilots for multiseat aircraft to the future one will proceed smoothly. They will have to work with a double load, since the process of emergence of young aircraft commanders in the regiments will proceed in parallel with the training of replacements that arrive from the schools.

I nonetheless feel that the measures listed above cannot be avoided in order to achieve a qualitatively new level of aerial proficiency for the crews of multiseat aircraft and raise the level of flight safety. One must arm oneself with everything positive and progressive that has been accumulated by our Air Forces. One time, for example, the flight personnel in the frontal-aviation units used to perform flights on MiG-15 and L-29 training fighters under IFR hoods in order to maintain their instrument flying skills. The trainer aircraft were thereby freed for basic operations, while the pilots received good practice. Why not create, say, prototypes of VTA combat aircraft for the same purpose?

We are reaping the fruits of our miscalculations in assimilating the An-124 even today. A situation has taken shape in which pilots flying the "Ruslan" are forced to maintain their skills in piloting, navigation and airborne assault landings by flying on the Il-76s they have mastered earlier. This substitution has not been successful due to the fundamental differences in these aircraft; the flights on the Il-76s are not much cheaper, either.

The creation of light and economical duplicate aircraft or prototypes of existing military-transport aircraft is undoubtedly a requirement of the times. It will be unforgivable if we do not address it. It is not for nothing that they say penny wise, pound foolish. We have always finally had to pay for little economies with millions of the people's money, and sometimes even human lives. I would not like to repeat the mistakes of the past.

New Krasnov Book on Fighter Tactics Favorably Reviewed

92UM0103D Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 7, Jul 91 (signed to press 19 Aug 91) p 8

[Article by Major-General Aviation G. Laptev under the rubric "New Books": "Fighters in Battle"]

[Text] What are the role and place of fighters today in the battle for dominion in the air? How can an enemy raid be repelled under the conditions of realization of defensive doctrine? What should the actions of the commander be in the presence of a command and control system with elements of artificial intelligence? And, finally, is bravery needed in aerial battle in the era of long-range weaponry?

The answers to these any many other questions can be found in the book "The Secrets of Irresistible Attacks" [*"Sekrety neotrazimykh atak"*—Moscow: Voyenizdat Publishing House, 1991, 272 pages] by Doctor of Military Sciences and Professor A.B. Krasnov. Its title corresponds entirely to the content. The reader is offered a detailed chronicle of the development of the tactics of fighter aviation over the last half-century with a demonstration of the problems of the past, present and future. The facts, and the examples to illustrate the ways of

solving them, are skillfully chosen. They are taken for the most part not from well-known books, but from the personal experience of the author—a participant in the Great Patriotic War working today in the realm of tactics.

The tactics of fighter aviation are considered with a regard for a whole variety of factors determining its development. Here are the enemy, the still-unknown combat capabilities of new-generation aircraft, and the command and control systems automating the processes of assessing standard tactical situations and decision-making. The author, analyzing the influence of those factors on these or those aspects of aerial battle, expresses a number of original, albeit debatable, positions. They are all set forth in the book from varying and, occasionally, paradoxical viewpoints; what is especially important, they provide food for thought.

Problems of moral and psychological training of the flight personnel are gaining particular significance under the conditions that have taken shape today. They are presented in broad spectrum in the book as well. Aviation commanders will thus not be uninterested in becoming acquainted with them. The discussion here concerns the overcoming of psychological difficulties in the emergence of young pilots, the assimilation of new aviation hardware and the causes of mistakes by experienced and beginning aerial warriors.

Take, by way of example, stressful situations—the actions of pilots under conditions of a scarcity of information and time with the failure of instruments or engines... How should he act? In considering these cases, we and the author analyze them together, seeking out and interpreting anew ways of escaping them and assessing the limits of reasonable risk.

One cannot, of course, agree unreservedly with all of the positions expressed by the author, and some elements can and need to be disputed. The suggestion to develop an algorithm for decision-making in a critical situation according to the principle of "If I don't know what to do, I'll do this...," for example, looks debatable. The meticulous reader will probably not be satisfied by the fact that too little attention is paid in the book to the combat operations of fighters under conditions of active electronic-warfare resistance by the enemy.

But that is, so to speak, wishful thinking. The reality consists of the fact that the book "The Secrets of Irresistible Attacks" enriches the reader's knowledge in the realm of tactics and the sciences associated with it. It will be a great help to command and flight personnel and to those who are interested in studying aviation and the martial arts.

Results of Flight-Safety Survey Analyzed

92UM0103E Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 7, Jul 91 (signed to press 19 Aug 91) pp 10-12

[Article by TOF [Pacific Fleet] Air Forces Commander-in-Chief Major-General Aviation V. Akporisov under the rubric "Flight Safety: Experience, Analysis, Problems": "Before Going Aloft"]

[Text] *One of the most difficult problems of aviation theory and practice over the whole history of aviation, from the appearance of the first aircraft right up to today, remains the reliable assurance of flight safety.*

Unfortunately, despite the reduction in the accident rate in the aviation of the USSR armed forces over the last twenty years, no radical change in the flight-safety situation in the naval Air Forces has occurred. The fact that personnel are to blame for 60-70 percent of the air mishaps that occur each year is evoking particular alarm. This distressing statistic testifies to the fact that everything is not in order in the organization and execution of preventive measures to ensure operational safety in the aviation units and subunits and in the TOF Air Forces Directorate itself.

We used to forget about the most important thing in our investigations of the causes of flight accidents, and issued recommendations on how to overcome their consequences—save the honor of the uniform, not discredit the reputation of aviation. But as is well known, one cannot devise an "antidote" to the disasters without knowing the true causes of air mishaps either. We must, in other words, battle the causes rather than the consequences.

It is becoming obvious today that the problem of flight safety cannot be solved through efforts from above, that is, primarily on the basis of norms and rules strictly regulating the activity of each level of the aviation system in planning, organizing and carrying out flights. There is no arguing, at the same time, that the development and incorporation of more progressive techniques, rules, guidance and courses of combat training have a beneficial effect on reducing the accident rate. The documents, however, cannot provide for everything. Real life is much more complicated, and not all of the negative processes affecting flight safety lie on the surface.

Experience testifies that flight accidents are usually born in the thick of the problems and negative factors that remain unaddressed by the commanders of subunits, units and large formations and the Commander-in-Chief of the naval Air Forces. We are convinced that the official information on the basis of which recommendations and manuals are developed, strange as it may be, loses its objectivity as it moves upward by stages from below due to the non-disinterested rounding off of sharp edges. It is difficult, or more accurately impossible, to

structure the work on preventing flight mishaps correctly at all levels of management on the basis of that same information.

The naval Air Forces command thus faces an exceedingly important and complex task—supplementing the information field and expanding the flow of information. We have decided to implement this via the creation and reinforcement of a system of voluntary reports, initially based on occasional, anonymous questionnaires for the flight personnel on problems of interest, and later on the basis of continuous, anonymous reports from pilots, navigators, engineers and technicians—from all the people supporting flights. These reports arrive addressed to the flight-safety service or the naval Air Forces Commander-in-Chief. They report mistakes committed in piloting techniques, in the operation or servicing of airframes and the making of decisions and their realization, as well as other acute problems affecting flight safety.

We feel that a system we have already tried out will make it possible to obtain the most varied, broad and valid information, not trimmed back out of fear of punishment, and that does not exist in any other official source. The main thing is that its analysis will provide an opportunity to determine the true causes of mistakes and work out the appropriate recommendations to eliminate them in flight operations practice in the units, subunits and large formations and the departments and services of the naval Air Forces directorate.

Some 127 respondents took part in the survey in 1988, and 94 more in 1989. The answers contained a wealth of information that required detailed processing. The appropriate decisions were made and recommendations devised on the basis of it, and corrections were made in the comprehensive program of the naval Air Forces to ensure safe flight operations in the units and subunits for the long term.

The most important result of this survey, in our opinion, was the trust that was displayed by the survey participants in the naval Air Forces command.

On the one hand, we meticulously fulfilled the rules of the "game": no one sought out the source of very "grave" information from the viewpoint of the threat to flight safety; no one instituted any organizational proceedings or reproaches against the commanders, and other ways were found to affect the state of flight safety in individual units of the naval Air Forces.

These mutual relations between the personnel and the command were fertile soil for the performance of an anonymous survey in 1990. Some 960 respondents, principally flight personnel, now took part in it.

They were all asked to answer the following questions:

1. How do you assess personal readiness for actions in special cases in flight?

2. Did you always perform flights being fully prepared for them, with full confidence in its favorable outcome?

3. What particular incidents have occurred in your flight practice that have remained unknown and were not counted as precursor conditions to flight accidents?

4. Do you feel the choice of the profession of military pilot was the correct one? Are you satisfied with the situation and state of affairs in the area in which you serve?

The participants answered the first question by putting down marks on a five-point scale: 15 percent of the respondents assessed their readiness for actions in special flight cases as excellent, 61 percent as good and 24 percent as satisfactory; no one evaluated his own preparation as being unsatisfactory.

These results are very hard to comment upon from the standpoint of objectivity. There is no doubt of the sincerity of the answers, but one must not forget that this is, as a rule, a personal assessment, and not the assessment of a subordinate by a commander. It is moreover not known to us whether life and flight operations have verified the high marks a person gives his professional training in the questionnaire. We are convinced of the unsatisfactory knowledge and skills of our flight personnel in eight out of ten cases in practice when investigating the precursors to flight accidents. And if practice is considered a criterion of the truth, them proceeding from such precursors we should be thinking about improving the system of training for flight personnel for actions in special cases in flight.

A streamlined process of theoretical training, practice and inspection checks of the flight personnel on the ground and in the air helps to reduce the number of mistakes to a minimum. It should not be forgotten, however, that it is characteristic of a person to err, and those mistakes can be explained first and foremost by the limits of his psychological capabilities, which can change even over the course of the day. We must take more complete account of the psychological state of the fliers. Accident-free operations both in the sky and on the ground are impossible without it.

The answers to the second question on the questionnaire, especially the first part of it ("Did you always perform flights being fully prepared for them..."), contradict the evaluations that were presented above.

Sixty percent of those polled answered "satisfactory" to this question; forty percent were unfortunately not always fully prepared for flights.

It is fitting to ask here how one can feel ready for actions in special cases without being fully disposed toward a planned flight. The aircraft, after all, is not subordinate to any other authority, it is obedient to the pilot with high professional and psycho-physical readiness for a specific flight alone.

There was, for example, an accident in the aviation of the Black Sea Fleet on 1 Aug 90 involving a MiG-29U aircraft. It was being piloted by a crew composed of regimental navigator and Combat Pilot 1st Class Lieutenant-Colonel O. Omelchenko and instructor/test-pilot 1st Class A. Kvochur. The cause of the accident was the erroneous actions of the pilots when operating the control levers while performing advanced aerobatic maneuvers at low altitude. It was established during the course of the investigation that instructor Kvochur was not present at the preliminary preparation for the flights, and he had neither studied himself nor prepared his trainee for the planned combat-training mission; he was relying on his wealth of experience in flight operations as a test pilot. An expensive piece of hardware was lost as a result, with material damages to the state.

There were flight accidents due to poor instructor preparation in our units as well. The most characteristic of these occurred on 22 Sep 88 in the regiment where Lieutenant Colonel A. Desyatnikov serves. Flight commander Major A. Konnov was showing his trainee an advanced aerobatic maneuver at low altitude, for which he himself was not prepared either as a pilot or as an instructor. The plane hit the surface of the water and both pilots perished as a result.

Individual answers presented the reasons that did not permit them to be fully prepared for the flights. There were two: too little official time is allotted for independent training; and, the time that does get allocated for those purposes is wasted on filling out flight documentation and composing various methodological aids, as well as studying orders and other documents from higher headquarters.

In commenting on these objective reasons, I would like to admit candidly that over the 26 years of my service as an officer in all positions from copilot of an aircraft (I served as one for four years) to the Commander-in-Chief of the naval Air Forces, I was always and am always disastrously short of time for work on myself. I am not even talking about official time now. There is one prescription here: skillful planning and high organization on the scale of the air regiment, squadron or detachment. The personal work of any specialist cannot be managed without the simplest planning either. The desire to work is a plus.

The reasons for a lack of confidence in a favorable outcome for a flight were given in the answers to the second part of the second question on the form. There were five:

—lack of systematicity in flight operations;

—poor professional knowledge and flight skills;

—imperfect navigational equipment on aircraft that fails often;

—poor reliability of equipment and outmoded aircraft; and

—the unpredictability of the outcome of any flight.

What steps have been or will be undertaken by the naval Air Forces command in regard to this information?

First of all, the commanders of flight units have been ordered by 1 Nov 90 to provide minimum flying time for all crews of 70 hours for heavy aircraft (helicopters) and 50 for attack aircraft. It is further recommended that the unit commander establish personal monitoring of a pilot with less than 25 hours in a quarter and take steps to ensure regular flights. This requirement has been backed up in a material sense (supply of fuel, aircraft and special equipment) in all flight units, and will be fulfilled by and large by the indicated deadline. The subunit of Lieutenant Colonel A. Desyatnikov—whose people are bring retrained on new equipment, and there is little of it at the airfield—is an exception. Even there, however, if the command of the unit gets rid of stereotypes on organizational issues connected with the preparation and execution of flights and the necessary flying time more boldly, they will still be able to provide for 90 percent of the flight personnel.

Second, we have to look for our own share of the blame in the high failure rates of the equipment. These include the poor professional knowledge and skills of the specialists servicing combat equipment. Complaint work directed to the aviation industry and the aviation repair enterprises is also not skillfully done in the TOF Air Forces.

Things are especially unfavorable in this regard in the units where the officers V. Rubanov, V. Sosnin, T. Levkin and G. Manishov serve. The engineering and technical staff makes no complaints against MAP [Ministry of the Aviation Industry] during the period of guaranteed operation, supposedly in order to maintain a high level of combat readiness for the aircraft in exchange for scarce spare parts for the aircraft. The illusion of highly reliable aviation hardware is thereby created artificially.

The third question on the questionnaire was the most interesting in the anonymous poll. One can evaluate from it the degree of validity of the official reporting on flight safety, the trust of the survey participants in the fleet Air Forces command and their vested interest in accident-free flight operations. We express gratitude to all the fliers who took part in the anonymous questionnaire for their candor and desire to eliminate accidents in the naval Air Forces units, and we would like this flow of information to continue. We are furthermore ready to receive anonymous information at any hour of the day by telephone about a threat to flight safety for the immediate adoption of measures to localize it.

Some 85 percent of the participants in the anonymous survey in 1990 answered that not a single dangerous instance in flight had been concealed; 15 percent reported dangerous situations from which they emerged the winner but did not make known to the command of the unit or the naval Air Forces. Their comrades also do

not know about them, and therefore cannot employ the experience in flight practice.

The idea that the pilot has the right to make a mistake is breaking through with difficulty today. We must seek out the reasons for these errors and eliminate them when investigating the actions leading to air mishaps. Punishment for a mistake should not and cannot be the principal means of averting a repetition, since it does not eliminate the causes that gave rise to it, pushes the investigation to the side and creates the illusion of taking steps, psychologically traumatizing people and driving the "disease" inside. This kind of accident "prevention," when the desire is to find and punish those to blame, creates a tense climate in aviation collectives at all levels along with an unfavorable psychological climate founded on a dual morality, lack of candor and insincerity in mutual relations. All of this, of course, cannot facilitate a rise in the reliability of flight operations.

We will not comment on the dangerous situations that were enumerated in the answers; there were many of them, and each merits special discussion. We will note just those most often repeated:

—drops in cloud cover below the minimal safe altitude in landing approach—11 instances;

—dangerous convergence with other aircraft through the fault of the flight-supervision group—9;

—landing on emergency fuel reserve—5;

—temporary loss of orientation outside the air-traffic control zone—5;

—getting into a vortex loop with later favorable escape from it—4;

—loss of speed below minimal to gain altitude—3;

—unintentional drop in altitude below 200 meters—3;

—loss of cabin pressurization at high altitudes due to unsatisfactory monitoring on the part of crew members—3;

—getting into the wake of a lead aircraft at an altitude close to the effective ceiling—2;

—failure of altimeters at very low altitude—2;

—drop in altitude below safe level at night in bad weather conditions in the area of the Kurile Ridge—1;

—loss of spatial orientation over the sea due to poor preflight rest—1;

—takeoff at night with gyroscopic horizon and other piloting instruments turned off—1; and

—touching the ground 600 meters short of the runway with subsequent second pass—1.

We hope that every air commander, navigator and pilot who becomes familiar with the data from the survey will be able, on the basis of it, to carry out purposeful work to prevent similar incidents, and will not miss opportunities for improving considerably his own personal flight preparation.

Some 84 percent of those polled answering the first part of the fourth question ("Do you feel the choice of the profession of military pilot was the correct one?") said that they had consciously chosen flight work and were committed to it, and another eight percent had no unequivocal opinion of the correctness or error of their choice of profession; the rest declared that they had not erred in their choice of profession, but there was not a single pilot among them.

The powerful crush of service and social problems caused dissatisfaction with the results of their work for 84 percent of the flight personnel polled. The following reasons were cited as arguments in answers to the second part of the fourth survey question ("Are you satisfied with the situation and state of affairs in the area in which you serve?"):

—the enormous paper and reporting red tape after the completion of the assignment, which provides no opportunity for the quality preparation for later flights and causes irritation and dissatisfaction with the effectiveness of one's work—70 percent;

—dissatisfaction with housing, lack of amenities for children of pre-school age and unemployment among wives—47 percent;

—little flying time and poor regularity of flights—31 percent; and

—distraction of flight personnel for the performance of housekeeping work (unloading railcars, preparing garrisons for winter, stocking vegetables)—22 percent.

Nineteen percent of the respondents among the flight personnel, in their answers to this survey question, pointed out the poor material supply and lack of correspondence of pay and benefits to energy expenditures; 15 percent of those polled are troubled by the low prestige of flight work both in the armed forces of the USSR and in society as a whole; 17 percent are not satisfied with the poor organization of flights and the poor support for them, leading to disruptions in planned combat-training sorties; 11 percent feel that their immediate commanders do not fit the positions they hold in their level of flight training; four percent are angered by the arrogance, rudeness and lordliness of superior officers; 15 percent are dissatisfied with the condition of aviation equipment; and, nine percent of the survey participants cite over-simplification and formalism in flight operations as some of the chief causes of accidents in TOF Air Forces aviation.

These are the real anti-stimuli that are gravely wounding the mind and soul of the fliers and causing dissatisfaction with the results of their work, even among those who are deeply committed to aviation.

It should be noted that there are 878 families without apartments, including 297 families of flight personnel, in the Pacific Fleet Air Forces alone, with 1,933 families living in substandard settlements and needing improved housing or huddled together in decrepit houses from the 1930s and 1940s, including 637 families of flight personnel. There are lines to get children into nurseries or kindergartens at all garrisons. Just 40 percent of the flight personnel can restore their health at rest homes or sanitoria.

These figures are wholly explainable in view of the poor prestige of flight work in society and in the armed forces, but if the USSR Supreme Soviet and the Soviet government do not make the appropriate decisions for servicemen in general and flight personnel in particular in the future, especially under the conditions of a transition to the market, these figures will be changing sharply for the worse.

The fleet Air Forces command feels its chief task is to eliminate the anti-stimuli having a negative effect on the flight personnel in the shortest possible time and to appeal to the commanders of the units and subunits to support us with practical steps. Everyone who is excited by accident-free flight operations by our crews can write to us (including anonymously) with their views on the problem of flight safety and mistakes and omissions at all levels of command and control, as well as all other urgent problems.

We express our gratitude to all of those who took part in the second round of the survey in 1990. We feel that all fliers should become acquainted with the results of the questionnaires, so that each of them can find his own place in the work to eradicate the causes of flight accidents that are the fault of the flight personnel in the naval Air Forces.

From the editors: *We will publish the results of the second round of the survey in the next issue of our journal.*

Multiple Causes of Accidents Beyond Pilot Error Examined

92UM0103F Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 7, Jul 91 (signed to press 19 Aug 91) p 13

[Article by Colonel Yu. Timchenko under the rubric "For Accident-Free Flight Operations!": "Established by the Commission... And Now What?"]

[Text] *From the investigation report from an air accident: "The cause of the aircraft crash was the pilot's failure to hook up the hoses of the pressurized helmet to the oxygen instruments after repeated checks of the life-support system on the ground, which led to his loss of ability to perform in the stratosphere..."*

The life of a pilot cut tragically short, great damage to the state and a loss in no way replaceable for the family of the deceased all lie behind the dry wording of the record...

The event being discussed took place in January of 1990 in an Air Forces unit. The pilot was assigned the mission of performing aerial reconnaissance in a MiG-25RB aircraft from the stratosphere. He was a first-class pilot in his level of training, had performed analogous missions many times and was ready for the flight that time as well.

Where in the aviation system did the breach form that led to a fatal outcome?

The answers to this and other questions were found in the course of an investigation of the flight mishap.

The pilot, having arrived at the hardstand in good time, checked the readiness of the aircraft for flight. He detected a lack of airtightness in the life-support system in the process of direct preparation of the cockpit (the failure was revealed when checking the oxygen system under excess pressure).

The pilot decided to make certain of the good working condition of the high-altitude partial-pressure suit, for which purpose this check was repeated on another two aircraft located next to the hardstand. The service crew was able to determine the cause of the airtight failure (a break in the airtight seal of the connector hose for the suit's main pressurization line) and eliminate it. No record was made in the aircraft-preparation log of the failure that had been detected or the work done to replace the hose, and the aircraft technician did not report the elimination of the flaw to his superiors.

Seemingly an ordinary incident in and of itself, often encountered in flight work. Had the pilot, aircraft technician and chief of the aviation-equipment group, having received the information on the failure, fulfilled their immediate duties, the pilot would have lived. But events shaped up differently. Time did not wait. After the elimination of the defect the pilot and technician, unfortunately, made certain of the airtight seal of the system under excess pressure only in one channel—the pressurization of the high-altitude partial-pressure suit—which could be checked out without hooking up the hose of the pressure helmet to the oxygen instrument...

At an altitude of 18,000 feet the aircraft, with afterburners operating, went into a descent at increasing speed. After 75 seconds the speed reached 1,760 km/hr according to the instruments, exceeding the maximum allowable for the strength of the design. The process of destruction of the aircraft was short-lived.

Is this the first time we have run up against this type of appearance and development of an emergency situation and its transition into a disaster? Unfortunately not. Another five similar accidents, four of which ended tragically for the crews, have been noted over the ten prior years in the history of military aviation. So why do

pilots lose their ability to perform due to oxygen deficit, year after year and for one and the same reasons, when performing high-altitude flights? Is there some general law in these events?

An entirely definite answer could be provided to the first question. The reason is the poor quality of the performance of investigations of past flight accidents, when the reason were by and large reduced to one thing—pilot error in the operation of aircraft equipment in flight. They found one factor that allowed them to determine the guilty party, as a rule, and further inquiry ended there. But to find just one reason for such a complex occurrence as an air accident, however, is to reduce all of the work of the commission only to a search for those who are to blame. This is the grossest of errors in the approach to accomplishing the main tasks of the investigation—ascertaining the true causes of the accident and devising proposals to rule out a repeat of it.

The old approaches to investigating accidents were reviewed in 1989, and the "Concepts for Averting Air Accidents"—based on the idea of the multifactored nature of the causes of crashes, accidents and the precursors to them—were adopted.

What are the principal factors facilitating the appearance of emergency situations due to repeating causes?

The first is haste. It is present in half of the air accidents under consideration, for example the takeoff from the alert flight of Captain M. Chipikov in 1984 or the performance of the first solo flight for acceleration and ceiling by young pilot Lieutenant O. Bychkov in 1986.

The second is the lack of professional preparedness of the pilots, and carelessness in the performance of prescribed operations before a flight. A regimental commander was killed in 1980 as a result of the incomplete checking of equipment in flight preparation. Later only the insistence of the flight operations officer, literally forcing a flight commander to abandon an uncontrollable aircraft, saved the pilot's life.

The third is the uncoordinated actions of flight and technical personnel in the immediate preparation of the aircraft cockpit for a sortie. This factor is characteristic of all the flight accidents investigated. The point is that the Aircraft Operating Manual, stipulating the actions of the pilot in preparing—and the procedure for checking out—the life-support system, prescribes that the aircraft technician perform the checking under excess pressure, which operation is not part of the standard servicing procedures and, as a consequence, is not performed by the aircraft technicians.

The fourth is a design factor. A likelihood of erroneous actions exists in the activity of every person. The designers should proceed from that idea as well. If there is even a small possibility of an error, design measures must be adopted to avoid it. Our designers have unfortunately not yet been able to create reliable systems for life support that are protected against errors and, at the same time, get rid of everything extra that makes the conscious activity of the operator more difficult.

The commissions that investigated the aforementioned flight accidents noted and passed along to interested organizations entirely concrete measures aimed at raising the functional reliability of the life-support system. Follow-ups unfortunately show that the state of affairs is not changing at all levels. There is no confidence that the cause of the next flight accident will not be a breach in the operability of the life-support system, noted more than once already, and everybody will not be proving to each other once more time, from a lofty human and moral stance, that flight safety is a state matter, a common cause...

Variety of 'Abstract' Factors Affecting Causes of Accidents Explored

92UM0103G Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 7, Jul 91 (signed to press 19 Aug 91) pp 14-15

[Article by N. Nosov, senior scientific associate of the Center for Sciences of Man of the USSR Academy of Sciences under the rubric "Military Reform: Socio-Economic Aspects": "The Pilot, Psychology and... Money"]

[Text] *The old problems of aviation are coming forth in a new light with the country's conversion to market relations and the foundations of a law-governed state. Whereas they used to be assigned the status of "theoretical," "academic" or even "far from life," today they are proving to be the essence of the matter, about which in the not-too-distant past, we admit, hardly anyone was seriously troubled. The problems were "solved" from the standpoint of strength (he with more rights was right) or were camouflaged altogether with the aid of formalized organizational measures and quasi-scientific terms. The taxpayers, that is the people, were meanwhile kept ignorant of aviation problems while paying for it all. The absurdity of this state of affairs was manifested in aviation in special cases—accidents and crashes.*

I am sure that many fliers by now have a bitter taste in their mouths from the idea that has taken hold in public opinion that it is the person who is to blame for air crashes more than 70 percent of the time. But where did that opinion come from? One thing is clear: it is very convenient for design engineers, designers, the administration and accident-investigation commissions. And directed against the person operating the aviation equipment—the pilot, navigator, operator or engineer. One "specific feature" of these figures is the fact that they make it possible for the causes of accidents to be laid on the "little guy" operator and remove responsibility from other officials. Truly the weak carrying the strong!

Improbable, but true. Whatever bad things we may have to say about the, so to speak, extra-market command-economic system, however it may be criticized, it was humane in a way in regard to aviation. After all, even if a pilot used to be deemed guilty of an accident and discharged from aviation, he remained face to face with his new life and had no burden in the form of economic sanctions. Today, with various social structures gaining the status of a legal entity bearing material liability, everything is changing. Today it is the individual deemed (or designated?) the guilty party, rather than the state, who pays.

The pilot proves to be the weakest link in the new system. He has neither the right nor the opportunity to stand up for himself. And that signifies that the blame for the pilot in air crashes could reach 99 percent in the near future. It is thus not enough that the pilot will be thrown out of aviation; he will also still be obligated to pay enormous sums as compensation for any material damages caused. The pilot thus proves not only to be as poor as a church mouse, but also in debt up to his ears! There have been precedents already.

I want to be understood correctly. I am far from making it my task to fan tensions in an already tense socio-economic environment. My statements are based on the fact that such an important problem as clarifying the reasons for an air crash and the establishment of the guilty party has not been thought through in our country—not only from the scientific point of view, but also from the standpoint of common sense. Science, of course, is a complicated matter. Common sense has lately, if not triumphed, at least begun to reveal itself openly and penetrate into public opinion thanks to the efforts of AVIATSIYA I KOSMONAVTIKA.

I feel it is essential in this regard to address some of the elements that used to be considered "academic" and which even today continue to be neglected in the higher echelons of aviation authority, but which have to become, in my opinion, the "flesh and blood" of aviation.

The separation of powers. The policy of the separation of powers is one of the fundamental principles of the law-governed state. It is beginning to be realized and incarnated in our society as well. The essence of it consists of the presence in society of an equilibrium of legislative, executive and judicial authority. This equilibrium ensures the observance of legality, as well as the rights of the individual person before the state and the administration.

Such a separation is lacking in aviation (both military and civilian). The pilot remains face to face with the command, and depends almost entirely on it. Various bodies at some level are moreover always subordinate to one individual in the administrative-command system, and they thus observe each others' interests. A commission to investigate a flight accident, for example, is "bound up" with the interests of the Air Forces and MAP [Ministry of the Aviation Industry] and is in no way united with the interests of the "offender" in the accident. Legal authority does not extend to anyone therein. All are subject to no jurisdiction.

It is completely obvious that a commission to investigate an accident should include, first and foremost, a representative of the interests of the pilots, an organization of the "Association of Pilots" type, for example, as well as independent specialists—legal scholars, psychologists, medical personnel and the like—hired by it. The command will thus have to prove the guilt of the pilot in those circumstances, and not simply seek out a "scapegoat." Instances of a lack of coincidence of the opinion of the command and the commission would be subject to independent court examination.

At least two obvious conclusions follow from the aforementioned. The first is that their own independent, official organization must be created for the pilots, with the right to delve into all aspects of the pilot's life and represent his interests before the command. The second is that all the aspects of the pilot's life must be looked over once more, but from the point of view of the pilot himself and his interests rather than that of the command. As paradoxical as it may seem at first glance, it is namely a coordination of the interests of the pilot and the command that will ensure maximum combat readiness, and not just the observance of the "higher," often egotistical, interests of the command.

One such aspect of the pilot's life is the errors that occur in the course of flights.

The concept of an error. There are many different definitions of an error, but they all proceed from contrasting the categories of "correct—incorrect," or, in other words, "true—false." The binary logic of "truth—lie" is implicit in the definitions. It follows, according to this logic, that what the did pilot was incorrect, and was an error. Life is considerably more varied, however, and is not reduced to just two categories. A non-explicit substitution of concepts, a deception, is thus present in the definitions of errors, with the aid of which the reduction of the whole diversity of actions to the two categories of "correct—incorrect" occurs.

It is obvious, meanwhile, that not everything "incorrect" is an error, and the pilot should not bear responsibility for all irregularities in his behavior. The reduction of types of deviations to one—error—signifies charging the pilot with responsibility for all irregularities that occur in aviation. The pilot is the final link in the long chain of the aviation system, and all irregularities are ultimately reduced to him. It thus obtains, given that the concept of the error is set namely by a categorical binary system, that the responsibility of other officials is shifted onto the pilot.

I would single out at least eight such types of deviations, each of which is answered for by different people: forced action, spontaneous action, crime, offense, weak will,

delusion, trial, error (see AVIATSIYA I KOSMONAVTIKA, 1989, No. 6). Learning about deviations in the behavior of the pilot should be developed in aviation, since confusion in this will lead to the fact that the pilot is forced to pay for the sins of others.

The image (model) of a person or, more precisely, the anthropological prototype of the pilot. This abstruse word once again becomes substantive when the discussion touches on how to pay. At the foundation of every gesture, as is well known, there lies a certain image of the person toward whom the gesture is directed. The definite image of the person making the gesture is also embodied in that gesture in exactly the same way. There are commanders, for instance, for whom a subordinate is a featureless mechanism intended for the fulfillment of orders, and there are commanders for whom a subordinate is a person with spiritual impulses and personal problems—that is, each of these commanders has a different image of the person.

The anthropological prototype is a way of life, a method of understanding, a nature of mutual relations with other people—the fact that the person is aware of himself and the surrounding world. The anthropological prototype, in brief, is that which the person constitutes.

Our image of the person is specific for each of us, contemporary people, for whom a feeling of personal dignity, freedom of choice and sophistication of behavior is typical first and foremost. These features, however, are expressed in different ways in different people.

Now we will address how the guidelines are composed, how the statements of the conclusions of accident-investigation commissions sound, how the commander often treats the pilot: "...the pilot should," "the pilot is obligated," "the pilot did not display proper attention" and the like. An automated machine, a mechanism, a transmitting link in the system, in other words, is taken as the anthropological prototype of the pilot. Almost the entire life of the pilot takes place under compulsion. He cannot refuse to fly, he cannot complain about his health, about difficulties in life, because in that case he will be considered a broken piece of equipment with which there is but one thing to do—throw it on the junk pile. Such a concept as the "personal opinion of the pilot" does not in fact exist. It is not for nothing that fliers realize that they feel themselves to be people only in flight, that is, at least somewhat separate from the bosses and life's hassles.

When will we get the truth—only a free person can act with the greatest return, effectiveness and reliability?!

The anthropological prototype plays an important role in seemingly purely technical issues, such as how the cockpit is designed, how the control elements are executed and how the indicators are designed, as well as in interpersonal relations.

We will consider a specific case. Flights tests of a landing-gear retraction and lowering valve were underway with the aim of averting cases of unintentional wheels-up landings. The assignment consisted of the following: test the new valve on three flights in a circle with simulated landings. The pilot came around to land three times, having lowered the landing gear in good order, after which is was noted in the conclusion that the new version of the valve **permits** the error-free lowering of the landing gear before landing. The results of the test were deemed positive, and the adoption of the modification was recommended for aircraft of all types.

Without going into the evaluation of the modification itself, we will note the image of the pilot, his anthropological prototype, inherent in these tests and what follows from it.

It is assumed in this method of testing, first of all, that all pilots are equivalent to one another, and the results of testing with the involvement of one of them can be transferred to the others accordingly. Second, the pilot's method of functioning is always and in all cases one and the same regardless of the degree of his responsibility, his functional state, the state of the aircraft systems and external circumstances, and the results of the testing in one situation are thus transferable to all others. Third, the pilot possesses an absolute awareness, that is, such awareness that he will always be monitoring everything regardless of how many and what events are occurring at a given moment, and the test may thus be conducted only in a normal situation and the results can be transferred to any emergency or complicated situation. Fourth, the pilot is an unconscious being in which the concepts of "should" and "can" are equivalent—if he "can," then he "should." As soon as the pilot **can** avoid making an error, he **should** always avoid making an error.

But a coincidence of the modalities of "can" and "should," after all, is characteristic only of unconscious beings and inanimate objects subordinate to the play of the objective laws of nature. A rock thrown from above has no choice whether it "can" or "should" finally fall—if it can (nothing is holding it), then it should. A distinctive, to put it mildly, image of the pilot, as we see, has been given in these tests: exceedingly far from reality, first of all, and contradictory as well—the pilot both possesses and does not possess consciousness.

All of these sometimes seemingly abstract reasonings have real and "down-to-earth" substance. It is always implicit in the tests being conducted that if the pilot does not lower the landing gear, then always and in all cases he and only he, without any justifications, will be *a priori* to blame for it and, consequently, will bear legal and material responsibility for the consequences. These tests, in other words, were conducted not to check out the new element, but rather to "hang" the blame on the pilot forever.

Just three of the "abstract" psychological elements (the separation of power, the concept of an error, the anthropological prototype) in the vital professional activity of the pilot, which nonetheless play a key role in flight practice and in determining responsibility for an incident, have been considered here. There are many such elements. And how many more technical, organizational and other nuances there are! The time has come to reveal them all. Who will take it up?

Brief Overview of Career of MiG-23 Fighter

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[Article by Colonel A. Kanevskiy and A. Popov under the rubric "Soviet Aviation Technology": "The MiG-23: Strokes in a Portrait"]

[Text] One can scarcely find a person in the armed forces who is not familiar with the MiG-23 aircraft. Developed in the 1960s, it became one of the "mass" fighters of the Soviet Air Forces. This craft was noteworthy for many of its innovations for the times. A light multirole close-support fighter with variable-sweep wings in a range from 16 to 72 degrees had been built for the first time in the history of aviation. Its creators had to walk a largely untrodden path.

Everything was new—its aerodynamic configuration, which had to allow for preservation of the aircraft stability, its high maneuverability and its good controllability across a wide range of speeds, altitudes and G-forces; its swivel assembly for the wing, providing for reliability in changes of wing sweep in flight, the airtight seal of the connections in the fuel lines from the wing tanks to those in the fuselage, and sufficient durability in design, allowing the craft to perform missions successfully both in the modes of ferry flight and in maneuvering in aerial battle at high G-forces.

The design of the main landing-gear struts was also distinguished by innovation (never before used on MiG-type fighters), and had to provide for compactness in retracted position (in the fuselage) and sufficient strength in lowered position regardless of the type of runway—concrete or dirt—on which a hard landing is being made. As was the monocoque design of the fuel tanks, also not employed on aircraft of this class and providing a maximum capacity greater than the built-in rubber ones that were employed earlier. The MiG-23 also employed such innovations as four air brakes, allowing the aircraft to shed speed quickly, which is important in aerial battle, as well as spoiler control of banking with the simultaneous use of the "scissors" stabilizer mode, providing for sufficient maneuverability in all flight modes, a ventral aerodynamic fence deploying when the landing gear is lowered... And much more, fundamentally distinguishing this aircraft from its predecessors.

The MiG-23 met the Air Forces requirements of the time in performance characteristics, underwent a whole set of plant and joint state testing and was accepted for service. This aircraft, series-produced in various versions, has proved to be long-lived in fighter aviation. It has been in service for over 20 years now. Constant improvements in the design of the airframe, systems and on-board equipment, along with refinements raising operational reliability and combat effectiveness, allow the MiG-23 to stand confidently in defense of the air borders of the Motherland.

The MiG-23 has not been shortchanged in attention from domestic and foreign specialists over its long life. It was deemed the most significant fighter in the 1970s. Much has changed over the twenty and more years, however, including aviation design thought. New concepts have appeared, and the attitude toward the once shining aircraft has changed.

Today's attitude toward the MiG-23 fighter on the part of flight, engineering and technical personnel is equivocal. The "rating" of the craft is not a high one in the line units. There is no point in dwelling on the reasons and analyzing them for the purpose of solving the problem of improving the aircraft, since the MiG-23 is living out its days. A new generation of fundamentally new fighters has come to replace it. But the place of the MiG-23 in the history of our aviation, and in the history of the OKB [special design bureau] that created it and recently observed its 50th anniversary, is so large that we do not have the right to consign the MiG-23 to oblivion.

The experience in designing the aircraft did not go for naught. The solution of the fundamentally new problems that arose in its creation provided invaluable experience for a whole constellation of designers and engineers. Many of the design features found in the MiG-23 were employed in later projects of the OKB imeni A.I. Mikoyan.

A whole generation of Soviet pilots grew up with this aircraft. It was taken up by Hero of the Soviet Union Major-General Aviation Aleksandr Vasilyevich Fedotov, two-time Hero of the Soviet Union Colonel-General Aviation Mikhail Petrovich Odintsov and USSR Minister of Defense Marshal Aviation Yevgeniy Ivanovich Shaposhnikov. The MiG-23 completed the combat schooling of Afghanistan in worthy fashion. Fire ramming was performed using this aircraft for the first time in the history of worldwide jet aviation by internationalist-soldier Lieutenant Colonel Anatoliy Nikolayevich Levchenko, decorated with the lofty title of Hero of the Soviet Union for his heroic deed.

There is no need for specialists to talk about the technical data for the aircraft, but we present here its principal characteristics for our readers:

Mass of empty aircraft, kg	10,000
Maximum takeoff mass, kg	17,800
Top speed, km/hr	2,500
Ceiling, meters	18,600

Takeoff run, meters	800
Landing runout, meters	750
Length of aircraft, meters	16.7
Height, meters	4.8
Wingspan, meters:	
—with extended wings	13.95
—with retracted wings	7.78
Power plant: R-27 or R-29 single-flow turbojet engine with maximum thrust, kgf	12,500
Armaments:	
—built-in dual GSh-23 cannon	
—air-to-air and air-to-surface missiles	
Total mass on racks, kg	3,000

Pilots Said to Be Kept in Dark on Hazardous Theoretical Phenomena

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[Unattributed article under the rubric "Aviation Practicum": "Why Deceive the Pilot?"]

[Text] More than ten years ago, researching the process of piloting an aircraft under the conditions of large G-forces, scholars detected a paradoxical phenomenon. Special sensors attached to the muscles of the pilot's arm recorded a pushing, pressing force to move the stick toward himself, even though the pilot should have been applying a pulling force to it.

It was possible to provide a quantitative assessment of the tactile activity of the pilot when piloting the aircraft via the removal of the mechanism of the trimmer effect of the forces being felt and the brief release of the stick ("The Effect of Associated Mass"—AVIATSIYA I KOSMONAVTIKA, 1985, No. 12).

It was thereby proved that there is an enormous difference between the characteristics of controllability (and, consequently, stability) presented in technical descriptions and those that were being felt by the pilot in maneuvering flight, conditioned by the weight imbalance and other "interference" in the "pilot—control system" control loop as discussed in the previous Aviation Practicum. A change in sign from minus to plus in such an important characteristic of controllability as the G-force gradient P_v^{Pu} is even possible at large G-forces, especially if the maneuvering aircraft is a two-seater and both crew members are interacting with the control sticks.

It is namely this that serves in many cases as a concealed source of such dangerous phenomena as the non-random over-pulling of the stick, leading to excessive G-forces or angle of attack with subsequent stalling, longitudinal surging, disruptions of interaction between pilots in controlling the aircraft in maneuvering, worsened conditions for aiming in aerial battle and the like, which does not permit the full realization of the potential capabilities of the combat aircraft.

Scientists and the designers of aviation hardware know about these phenomena and are conducting theoretical research and experiments, but they try to keep the pilots in ignorance of such "fine points." Everything in the textbooks is given, as before, from the viewpoint of designing airframes: characteristics of the loading mechanism instead of the controllability characteristics being felt by the pilot; static characteristics and intrinsic dynamic properties of the craft with immobile control levers or, in the extreme case, with a free stick instead of the theory of stability of a piloted aircraft.

Is all of this possibly being hidden from a potential enemy? The facts, however, testify that he is well acquainted with this and is working intensively on eliminating ergonomic shortcomings. The efficiency of the use of airframes and flight safety is being increased, including through simple design solutions. Examples of this are an optimally curved and short stick, making it possible to ensure the stability of the "pilot—control system" loop, hooking up additional sensory organs to the control process, and the use of a lateral stick with an elbow rest for highly maneuverable aircraft, which makes it possible to neutralize the effect of the associated mass of the pilot's body, along with a number of other measures.

Our aviation industry still has nothing special to boast about in the practical utilization of innovations in this realm. The classification of the topic dooms us to unwarranted losses of combat aircraft and people in our own Air Forces, not those of a likely adversary. The producers of aviation hardware and the authors of textbooks for flight personnel, of course, can find a simple explanation for their stance: "The customer (the Air Forces) does not require that of us..." A sensible question then arises: why ask only pilots and their commanders to answer for flight accidents connected with shortcomings inherent in the design of the airframes and the theory of flight?

Perhaps those who facilitate these crashes, wittingly creating hardware with flaws and deluding the pilots, could also be brought to strict account in accordance with their "contribution" as well?

What do the customer and the readers think about this?

Early History of Soviet Ballistic-Missile Development Related

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[Article by Doctor of Technical Sciences Yu. Mozzhorin and Candidate of Technical Sciences A. Yeremenko under the rubric "From the History of Space Science": "From the First Ballistics to..."]

[Text] The government of the USSR, on May 13 of the first year after the war, adopted a decree to create a missile industry as a special sector of machine building. The overall supervision of the work was entrusted to USSR Minister of Armaments D. Ustinov with the widespread involvement of enterprises in other industrial agencies. It must be said that Ustinov, engaged in the production of heavy weaponry, including artillery systems, was taking on a complex affair completely new to him, having discerned the future of the development of strategic arms in this "ugly duckling," while the leaders of the aviation industry did not display the requisite interest in the creation of long-range missiles, feeling them to be an inefficient weapon compared to aircraft. The guided ballistic missiles of the time actually did possess short ranges and poor accuracy, and had a comparatively light warhead with conventional explosives. The cost of each of them, at the same time, was commensurate with the cost of a medium combat aircraft. The principal organizational concerns rested on the shoulders of Ustinov's first deputy, V. Ryabnikov. He played a prominent role in the emergence of the missile-building industry.

The pilot organization for the development of liquid-fueled missiles—the State Scientific-Research Institute for Jet Armaments No. 88 (NII-88) of the USSR Ministry of Armaments—was created in the city of Kaliningrad, located near Moscow, in accordance with the decree and the order of the minister of armaments on the basis of the Artillery Plant No. 88 imeni M.I. Kalinin.

A complex scientific-research, planning, design and experimental-production complex had to be put together. Three principal structural units were created to accomplish the tasks posed. The first was an experimental plant. Artillery production had to be converted from series production to experimental production of a completely different type in the shortest possible time. The second structural unit was the special design bureau, which was based on thematic departments; each of them had its own shop. The department for the design engineering of long-range missiles was headed by S. Korolev. It later grew into the a major special design bureau and defined the thematic thrust of NII-88. The third structural unit of the institute—the scientific subdivisions—was assembled in 1946-47, with departments for materials science, strength, aerodynamics, engines, fuels, control, testing and telemetry.

A whole series of other newly created or refitted enterprises around the country were included in the development of missile technology along with the NII-88.

Intensive, purposeful and selfless work in the literal sense of the work by many thousands of scientists, workers and support personnel was required to transform the opportunities that were revealed into reality. This was facilitated by the skillful combination of operative organizational and management work by the special State Committee for Missile Technology, the USSR Ministry of Armaments and a number of other industrial ministries, whose enterprises were charged with the development of assemblies and units for outfitting the missiles and ground equipment.

Some 35 NIIs [scientific-research institutes] and KBs [design bureaus] and 18 plants took part in the development of the first R-1 missile alone. S. Korolev, taking into account the fact that most of them had different departmental affiliations, created the Council of Chief Designers for the operative resolution of all fundamental scientific and technical issues arising in the course of the development of the missile systems.

The first council included V. Glushko, V. Barmin, V. Kuznetsov, N. Pilyugin and M. Ryazanskiy. The high efficiency of the work of that body was ensured by the fact that all of its participants strove to solve problems in an optimal manner with full candor in their statements, proceeding from state interests and not the interests of agencies, individual enterprises or personalities, but at the same time not neglecting their problems and trying to help and meet each other halfway. Korolev thoroughly knew the real capabilities and the maximum level of perfection of technical developments of each of the participants in the work at any given moment in time.

Hero of Socialist Labor L. Gonor, the former head of one of the largest artillery plants in the country, Barrikady, during the war years, was named the first director of NII-88. The chief engineer was State Prize laureate Professor Yu. Pobedonostsev, and the SKB [special design bureau] chief was the chief engineer of the Barrikady artillery plant imeni M.I. Kalinin, K. Tritko. The only professional missile scientists at the institute were S. Korolev and Yu. Pobedonostsev. The latter was moreover soon transferred to the retraining of key personnel for the new sector, heading the newly created Academy of the Defense Industry. S. Korolev designated the young engineer V. Mishin, who had taken part in the development of the BI, the first Soviet jet fighter, as his first deputy. The chief of the planning sector, K. Bushuyev, came from that same aviation KB of V. Bolkhovitinov. They had begun working with Korolev back in Germany, as had B. Chertok, L. Voskresenskiy and V. Budnik, who came over to him from the NII-1 of the Ministry of the Aviation Industry (the former Jet NII). D. Kozlov, V. Kovtunenko, S. Kryukov, S. Lavrov, V. Makeyev, P. Meleshin, V. Prudnikov, M. Reshetnev, I. Sadovskiy, M. Khomyakov, Ye. Shabarov and other young specialists came to the department almost straight

from the classroom. They quickly rose to be deputies of Korolev and leading designers, many of whom later became chief designers and the heads of major KBs in the missile and space industry. The collective of the newly created NII-88 began working under the exceptionally difficult conditions that the whole Soviet people was experiencing at the time. People had to live in overcrowded barracks and tents, working without days off in hastily refitted hangars and auxiliary structures at the experimental airfield turned over to the institute for development. It is interesting to note that it was from namely that airfield in Podlipki in February and March of 1940 that the first flights of the RP-318-1 rocket plane, developed by Korolev at the RNII [Scientific-Research Institute of Jet Propulsion] before his arrest, were made. The engineering and technical personnel had to take part in building the work facilities, test installations and housing, dig up their own gardens, assist the kolkhozes they sponsored and, at the same time, keep up a pace of design-engineering and design work that is hard to believe today. And it must be said that none of the young people quit the collective at that time; on the contrary, each considered it an honor to work in such a crucial sector of the battle for scientific and technical progress and the reinforcement of the country's defensive capability. Korolev always relied on the young ones, but never neglected an opportunity to supplement the collective with experienced cadres, especially from among his former comrades-in-arms. He thus later assembled at his OKB many of his former GIRD [Group for the Study of Jet Propulsion] colleagues and associates from the RNII, including M. Tikhonravov, B. Raushenbakh and A. Pallo, naming them, as well as his former comrades on aviation matters P. Tsybin, P. Flerov, S. Anokhin and M. Gallay, to crucial sections of the work.

The most difficult problem of creating apparatus for the automatic and telemechanical missile flight-control systems, along with the systems for telemetry and trajectory measurements, was entrusted to NII-885, organized within the USSR Ministry of the Communications Equipment Industry, with its director D. Maksimov, chief designer for automatic control systems N. Pilyugin and M. Ryazanskiy for radio control systems. Their deputies N. Boguslavskiy, M. Borisenko, G. Glazkov, B. Konoplev, V. Kotelnikov, V. Lapygin, E. Manukyan and M. Khitrik, as well as B. Chertok, Korolev's deputy for control systems, all made outstanding contributions to the development of the first control and measuring systems as well.

The command gyroscope instruments were a specific part of the missile control systems, and their development was entrusted to the subdivision of chief designer V. Kuznetsov that was part of the MNII-1 of the USSR Ministry of the Shipbuilding Industry, soon split off into the independent NII-944 with an experimental plant. Deputies D. Rakevich, Z. Tsetsior and I. Sapozhnikov, as well as institute scientific consultant A. Ishlinskiy, played a large role in the creation of missile gyroscope instruments at the NII-944 headed by V. Kuznetsov.

The assemblies constituting the ground-equipment systems, including more than 20 units of transport, installation, fueling and launch equipment for the R-1 alone, were an important part of the missile system. Supervision of their creation was entrusted to the Special Machine Building SKB of the USSR Ministry of Machine and Instrument Building, where the chief designer was V. Barmin. During the war it developed series-produced prototypes of the Katyusha rocket launchers created at NII-3, and organized their modernization and manufacture at the Kompressor plant. Barmin's organization brought a group of design bureaus and plants from the ministries for heavy, transport, construction and road machine building and armaments, among others, into the development of production for the ground assemblies. The principal ones among them were the TsKTBM (chief designer N. Krivoshein), SPKB (V. Filippov), SOKB (V. Rozhdov), GSKB (V. Petrov, then V. Solovyev) and TsKB-34 (A. Makhov and Ye. Rudyak), as well as the Zhdanov Heavy Machine Building Plant, the Leningrad Mechanical Plant, the Kuznetsk Metallurgical Combine and the Kalinin Railcar Building Plant.

The development of the liquid-fueled engines for the guided anti-aircraft missiles was entrusted to the engines department of the NII-88 SKB (chief designer L. Umanskiy). The engine workers of NII-1 under the leadership of A. Isayev had also begun working in this direction, and were able to achieve the transfer of their own collective to NII-88 with the rights of a department. The activity of Isayev's staffers had a considerable influence on the development of all of domestic liquid-fuel missile engine building. They later laid the foundations for the creation of space engines and engine installations.

Work on ZhRD [liquid-fueled engines] for long-range missiles was given over to OKB-456, assembled in June of 1944 at Aviation Plant No. 16 in the city of Kazan based on the design collectives of V. Glushko and S. Korolev, which had by that time successfully completed the development of the ARU-1 aviation rocket engine installation with the liquid-fueled RD-1 KhZ engine for the Pe-2 jet aircraft within the NKVD system. The participants in that work were released from confinement, given awards and united into an OKB transferred to the aviation-industry system. This OKB was moved in 1947 to the aviation plant putting out the Li-2 transport aircraft under license.

The associates at OKB-456 and its experimental plant had been able to reproduce the design of the V-2 rocket engine with a thrust of 27 tons in one year. A year later they created the thrust-augmented RD-101 version with a thrust of 35 tons, and then the RD-103 with a thrust of 44 tons. D. Sevruk, V. Kurbatov, V. Radovskiy and G. Firsov, among others, made a large contribution to this work.

All of the measures to assimilate the technology of long-range ballistic missiles being implemented by industry underwent strict checking on the part of the

customer—the USSR Ministry of the Armed Forces [MVS]. A military scientific-research institute (NII-4) was formed in this regard, and its mission included the development of methods of testing, acceptance, storage and combat application of missile weaponry. The State Central Test Range was created in the area of the town of Kapustin Yar in Astrakhan Oblast for the performance of flight testing, and Lieutenant-General V. Voznyuk was named to be its first chief.

It was namely there that a successful launch of the first R-1 missile was made; it had a range of 270 kilometers and was manufactured entirely according to domestic plans at Soviet plants using our own materials. Types of production new to our industry and technological processes, such as the manufacture of large sheets from special magnesium steels and magnesium-aluminum alloys, new types of cables, relays and sensors, materials-handling machinery with hydraulic telescoping drive and assemblies for the storage and transporting of large masses of liquid oxygen with highly productive refueling equipment, as well as new methods for welding and new protective coatings, were all assimilated therein.

Nine rockets were launched in the first series of flight tests for the R-1. All the flights were completed successfully.

The testing of the new R-2 missile system with a range of 590 kilometers began two years later.

Articles Not Translated

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